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changes of chemical state in the heterogeneous material within the earth such that increase of pressure in time produces increase of density, and relief of pressure produces decrease of density.

The direct effects of erosion and deposition on temperatures in the underlying material are such as to cause changes of density opposite to those caused directly by the change of pressure and probably occurring later than those caused by changes of pressure.

Gravitation tends continuously to bring about a readjustment to isostatic conditions by producing a deep undertow from a region of deposition to a region of erosion.

This undertow by virtue of heat produced by internal friction and by virtue of surface compressive stresses in the horizontal direction tends to raise the surface of the neutral region between a region of deposition and one of erosion.

The phenomena of isostatic readjustments by gravitation are complicated. Actions involved at any one spot are a function of the facts at many other places and of the facts of earlier ages.

The material in the earth to a depth of 76 miles is weak under the action of forces applied for geologic ages. The effects of gravitation predominate over those of other forces to this depth.

JOHN F. HAYFORD

*THE MERSHON EXPEDITION TO THE
CHARITY ISLANDS, LAKE HURON*

For several years the University of Michigan Museum and the Michigan Geological and Biological Survey have been cooperating in a biological survey of the state. The survey has had a small annual appropriation for this work, and has deposited the collections in the museum, but the expeditions sent out from the latter have nearly all been made possible by gifts from persons interested in the progress of the work or in the institution.

In the summer of 1910, Hon. W. B. Mershon, Saginaw, Mich., placed in the hands of the chief field naturalist of the survey, who is also the head curator of the museum, a sum sufficient to send a small party to the Charity Islands in Saginaw Bay, for the purpose of investigating the fauna and flora.

The Charities comprise a group of three small islands situated near the mouth of Saginaw Bay. The largest of these, Charity Island proper, contains about 650 acres, Little Charity Island, the next largest, about 3 acres, and Gull Island is a small projecting reef, about a quarter of an acre in extent, that is not usually shown on the maps. The group is somewhat nearer the west coast than the east. As plotted on the Lake Huron Coast Chart No. 2, of the United States Lake Survey, the distances of the larger island (where most of the work was done) from the mainland are as follows: to Point Lookout, slightly north of west, six and seven eighths miles; from Caseville, due southeast, nine and five eighths miles; from the end of Sand Point, a little east of south, seven and three fourths miles; from Oak Point, south of east, nine miles.

The islands are of interest biologically in two ways. In the first place, as they have not been connected with the mainland since glacial times, the biota must have reached them over a stretch of water at least as broad as that which now separates them from the mainland. In the second place, they are apparently upon a migration route of many species of birds.

The men engaged to do the work and the groups to which they devoted most of their time were as follows: W. W. Newcomb (butterflies and moths), N. A. Wood (vertebrates), A. W. Andrews (beetles), Frederick Gaige (ants), C. K. Dodge (plants). The museum and survey are greatly indebted to these men, for they did the field work without other remuneration than their expenses, and are now preparing their results for publication. Acknowledgment should also be made of the assistance of the light-house board, Washington, D. C., and Commander C. B. Morgan, inspector of the eleventh light-house district,

Detroit, Mich., in granting permission to work on the islands. The assistance received in the field will be acknowledged in the several papers.

The results of the expedition will be published in various journals and in the annual reports of the Michigan Academy of Science under the common title "Results of the Mershon Expedition to the Charity Islands, Lake Huron." As most of the field work was done in the late summer and fall, the survey plans to continue the work in the spring and early summer of 1911.

ALEXANDER G. RUTHVEN
UNIVERSITY OF MICHIGAN MUSEUM

ARTESIAN WATERS OF ARGENTINA

THE climate of a part of Argentina is semi-arid, and the geological formations which are regarded as Quaternary and Later Tertiary are in the western and central districts of the country saline to a degree which indicates prolonged duration of aridity. The region of the pampas which covers the province of Buenos Aires and stretches northward west of the Parana does not exhibit this characteristic; it having apparently long enjoyed a more humid climate, as it does now. The foot-hills of the Andes are also well watered. But with the exception of these last-named regions, a great part of the country suffers from lack of good water. This condition may, however, be in some measure relieved by proper development of artesian supplies. Many wells have been sunk already, but without adequate geological investigation. In the pampas water is found at a general depth of 20 meters more or less, and is pumped to the surface by windmills. It may be said that the development of the livestock industry of Argentina would be impossible were it not for this supply which comes from eolian, alluvial deposits of Quaternary and Tertiary age. A different geological condition exists from the Rio Colorado southward in what may be best described as northern Patagonia. In that region there are local elevations occupying a middle position between the Atlantic and Pacific, composed of

granites and older rocks possibly of Paleozoic age, and rising to altitudes of 300 to 1,000 meters. These mountains are not represented upon any map and their distribution is not known, but they have been described by Moreno and other explorers. Upon their flanks there is an extensive formation of gray sandstone which attains a thickness of several hundred feet and is very porous. It slopes gently toward the Atlantic and pure water flows from it in outcrops near the coast. The head of water in these strata is unknown. Further south in Patagonia the central sierra is replaced by plateau country and in Comodoro Rivadavia, in latitude 46 near the coast, wells which were sunk by the government in search of water developed petroleum. There is a large area in this region in which the geologic structure and the possibilities of artesian water need to be developed. In the great plains east of the Andes there are glacial deposits which may furnish superficial supplies like those of the Dakotas, and the marine Tertiary and Mesozoic strata afford conditions not unlike those of southern California. Here as well as in the valleys among the spurs of the Andes from Patagonia to Bolivia the geological structure is complicated and the problem of artesian water is one of peculiar difficulty as well as of great interest.

Our present knowledge of these conditions rests upon reconnaissance work and the stratigraphic and paleontologic observations of the Geological Survey of Argentina. No work based upon topographic maps and systematic structure has as yet been undertaken. The problem is therefore one whose elements are as yet to be developed. The Argentine government is using every means to encourage settlement and development of the rich agricultural regions which lie in the zone of sufficient rainfall east of the Andes, and also the vast grazing district of Patagonia. In order to afford ready communication it is building railroads at great national expense and operating them. The need of pure water for locomotive use as well as for other purposes has thus been made critically evident,